
Rationalising the Future

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RATIONALISING THE FUTURE?: FORESIGHT IN SCIENCE AND TECHNOLOGY

POLICY CO-ORDINATION

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Commentators from diverse fields and backgrounds have argued the present innovation environment is one constituted by unprecedented levels of uncertainty. National Foresight programmes recently have emerged as a means of co-ordinating science and technology policies and responding to a condition of uncertainty and change. Perhaps the most systematic Foresight programme is that of the United Kingdom. This article discusses the response the UK Foresight programme offers to the present and future innovation environments. In doing so, it is argued we should examine how the 'need' for the programme is constructed and how that need is defined and shaped in relation to past UK science and technology policies. It is suggested that Foresight presents an ambivalent response to many of the concerns it proposes to address.

Introduction

It is often remarked that the coming of the new millennium offers an opportunity for reflection on the direction and desirability of change in society. In science and technology policy circles in the UK and elsewhere, such an opportunity often is used to revisit the question of how science and technology (S&T) can be harnessed to improve national competitiveness and commercial exploitation. As we approach the new millennium, there has been an acknowledgement in policy circles of the uncertainties surrounding S&T developments and the general inadequacies of attempts at planning future strategies on the basis of existing knowledge. In this vein, a recent book on managing S&T and foresight activities starts by noting:

the growing realisation, in all areas of life, that the future is not fixed. The idea that the future can be shaped or "created" has gained currency through the 1980s and is increasingly the basis on which companies and governments make their plans. By trying to make things happen, rather than guess what might happen, companies have to embrace uncertainty and deal with it by continually reviewing a wide-range of business options[1].

Decisions in organisations then can not be founded entirely on solid foundations, but instead they must rest on a shifting sand of uncertainty.

In the UK, the acknowledgement of this situation is portrayed as having precipitated the introduction of the Technology Foresight programme, now referred to simply as the Foresight programme. Foresight is a meta-level government programme, which took centre stage in the UK in the early 1990s. It was designed to provide an overall direction to and justifications for S&T policy. It seeks to co-ordinate research and innovation agendas across public and private organisations, industrial and

service sectors, and academic disciplines by developing new alliances between the producers and the consumers of knowledge.

Even in this cursory description of Foresight, it is apparent that the programme raises a host of concerns: the dynamics of inter-organisational relations, the processes by which research agendas and priorities are established, the degree and nature of autonomy in the practices of scientists and engineers, the relations of academic disciplines to each other and industrial knowledge, and the ends to which S&T are directed. Foresight also draws attention to a problem peculiar to its underlying justification and one which will be given substantial consideration in this paper: how should funding decisions today be affected by expectations of the future, a future acknowledged as uncertain and yet 'createable'. Numerous questions follow from this: what role should national policy play in co-ordinating organisations, how in conditions of uncertainty can some sense of direction and priority be given to research agendas, when does the need to make decisions today foreclose future alternatives, and who should be involved in attempts to derive future scenarios?

It is argued here that the first round of the UK Foresight programme (which is in its concluding stages at the time of writing) presents an ambivalent response to many of the concerns it proposes to address. This ambivalence stems from the ambiguities of the programme in representing and responding to conditions of uncertainty and the assumptions made within it about the rationality of the policy process. It is maintained that to understand the UK Foresight programme, we should understand how the 'need' for it is constructed and how that need is defined, in part, in relation to the wider political culture of UK policy making.

In making these claims about Foresight and considering the justifications given for the programme, this paper contributes to the broad literature on the rationality of the policy process. A traditional 'rational' model of decision making might see a policy implemented in discernible stages: a stage of formation, in which the objectives are established; a stage of implementation, by which these objectives are translated into actions; and a stage of evaluation, where practice will be monitored and information is fed back systematically into a new cycle, starting with the reformulation of objectives. In this sort of model, analysis plays a vital role in determining options, rather than say the historical and social backdrop against which decisions are made. A substantial body of research has questioned the merits of such rational models as an accurate description or even as an ideal for the operation of organisations [2,3]. Whereas mainstream policy studies in the past might have advocated the reduction of uncertainty through gathering and disseminating information [4,5], this model of organisations has been well critiqued [6].

Given the debates about the place of rationality within policy and decision making more generally, it is useful to ask how Foresight relates to these concerns. This is particularly interesting because while undoubtedly the vast majority of policies are presented in highly rationalistic terms, the future orientation of Foresight makes such a framing problematic. Although in some sense all policies are oriented towards the future, the explicit and long range timeframe of Foresight introduces fairly unique complications. The issues considered here centre around how the notion of 'rationality-in-uncertainty' is conceived of in Foresight and what the problems are of this conceptualisation. Stated differently, as will be shown, Foresight in many ways aspires to be a highly rationalistic programme, but also distances itself from such a characterisation. The question here then is in what ways are the formulations of the programme problematic.

The paper is divided into six sections. The following section sketches the formal organisation of the UK Foresight programme. The next section then considers the claims made for the basis of change in policy and the need for Foresight. The following sections go on to examine some of the tensions and ambiguities of Foresight in relation to uncertainty and policy making (section 4) and past UK S&T policy (section 5). With regard to the former of these, this elaborates on the strategies for co-ordinating different actors within Foresight by considering the characterisations of the decision-making processes implicit in the programme. The latter section asks how Foresight embodies some of the assumptions and limitations of past UK policy. It is often acknowledged that national Foresight programmes vary in terms of their means of consulting experts, their objectives, and their connection to policy decisions [7]. Even in multi-country overviews of Foresight, what is less discussed is the relation of the programmes to particular political settings. In doing so, these two sections examine

how the justifications and characterisations made in section 2 are responded to and sustained within the programme. The final section presents the conclusion.

The claims of this paper are supported by ongoing research that investigates the social and institutional dynamics that shape the implementation of the recommendations of the Health and Life Science (H&LS) Panel of the Foresight programme, secondary analysis, as well as more speculative argumentation. Although many of the examples raised here refer to the H&LS Panel, and therefore cannot be said to characterise all the Panels, much of the argumentation is pitched and substantiated at a generic level.

In outlining the ambivalences of Foresight, this paper can only make limited assessments of the programme. Despite the importance of evaluating Foresight initiatives, there is surprisingly little evaluation of these programmes internationally [9,10]. Rather than evaluate the effects of the programme on the agendas of organisations, the primary purpose here is to ask how notions about the future expressed in Foresight gain legitimacy and what assumptions those ideas embody. As will be made clear, these notions complicate any attempt to evaluate the programme.

Formal organisation of Foresight

A prominent proponent of Foresight programmes describes them as “systematic attempts to look into the longer-term future of science, technology, the economy, the environment and society with a view to identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic and strategic benefit” [8]. Technology Foresight in the UK has its origins with the 1993 White Paper *Realising Our Potential* [11]. In this Paper, Foresight was presented as a way of managing scientific and technological capacity and prioritising research. It was meant less as an instrument of making detailed predictions about markets and technical advances than as a way of looking at a range of possible future scenarios in order to shape the future.

The UK Foresight programme is just one of a number of national Foresight programmes, such as those in Germany and the Netherlands. These programmes differ in their organisation, but in general Foresight involves three processes:

- deriving a list of 'critical' or 'generic' technologies which can underpin several different areas of innovation
- a consensus-driven consultation exercise that tries to identify possible developments in science and technology which may help meet societal needs over the long term
- a priority-setting process for the science and engineering base.

The 1993 White Paper declared that Foresight would inform the decisions of individual firms and research organisations regarding future technologies and markets, help the policy-making process, increase communication and understanding between the scientific community, industry and government, and enable the government to set priorities for the science base. The benefits of Foresight are supposed to derive from the process of conducting the exercise as much as from the recommendations and policy implications that come from it. As *Realising Our Potential* noted: 'The aim [of Technology Foresight] is to achieve a cultural change: better communication, interaction, and mutual understanding between the scientific community, industry, and Government Departments' [10].

The UK programme was organised into 15 (and later 16) sectoral panels within an overall Steering Group. The panels consisted of a mixture of academics, industrialists, and policy-makers, ideally representing the important actors in each sector. As part of the process, Foresight included a variety of means of consulting academic and industry experts, such as regional workshops and the use of Delphi surveys. Despite the use of such techniques, much of the identification of priority areas and the specification of recommendations took place in the panels. For reasons such as time constraints and time delays, the Delphi ultimately figured very little into the Foresight process itself.

The first set of priorities specified in 1995 attempted to identify those areas of strategic research likely to yield the greatest economic and social benefit in 10-20 years. Georghiou [7] described the criteria for prioritising in Foresight as:

- * economic and social benefits;
- * ability of the UK to capture economic and social benefits;
- * likelihood of scientific or technological breakthroughs;
- * strengths of the UK science and technology base;
- * cost of investing in new science, engineering, and technology;
- * the timescale within which new technology is likely to become available.

As the original name implied, 'Technology Foresight' was supposed to concern itself primarily with the identification of future strategic technological and innovation opportunities, rather than trying to specify scientific developments. As was explained, "the Steering Group decided to follow a largely market-driven approach by first identifying future markets and then the technologies, and related scientific research, which underpin them" [12].

The sense of institutional steering takes on a very specific meaning here. Co-ordination in Foresight is not 'government' or some other group telling others what to do in an authoritative and isolated manner. Rather Foresight is presented as involving a process of aggregation whereby research agendas can be determined by academics, industrialists, and policy makers and then followed by an establishment of institutional arrangements (e.g., funding structures) to enact the set of priorities identified. From the Foresight consultation, a fair degree of consensus was supposed to form. As such, Foresight, like many other science policy initiatives, both tries to align researchers and others to certain objectives, while acting as a means for researchers to advance their objectives. How such a consultation process which incorporates both of these dynamics gets translated into specific policy decisions is an additional matter.

It is apparent from above analysis that in practice the Foresight programme must balance certain tensions. Numerous difficulties in conducting Foresight type exercises are regularly acknowledged, such as:

- * the desirability of consulting a wide range of people must be balanced by practical considerations. In that light, Foresight panels consisted of a relatively narrow range of participants. This might have had a biasing or a conservative effect on priorities and networking;
- * the sector division of Panels may limit the extent to which as yet unrecognised cross-sector technologies can be identified;
- * technology-push and demand-pull factors need to be balanced in determining priorities;
- * basic research may be threatened by the drive for relevancy if proper precautions are not taken.

The extent to which these tensions manifest themselves depends, initially, on how much Foresight activities affect practices within the public and private sector. These acknowledged difficulties though, while important in their own respect, only touch on a small number of tensions that any foresight-type exercise has to balance. In developing a sense of what others there might be, it is necessary to

examine more thoroughly the need for Foresight and how it responds to changing conditions in the production of knowledge.

Constructing and supporting the need for Foresight change

This section maps out the conception of change offered by proponents of Foresight. It attempts to summarise the flavour of discussions surrounding the programme in central documents. In doing so it considers the functions that 'change' serves as a rhetorical device in policy. In a classical notion of rational action, the first stage of policy making consists of clarifying the reasons and objectives for undertaking some initiative. The section does not consider the empirical accuracy or explanatory capacity of the claims examined or the effectiveness of the Foresight programme. Rather it asks how the discourses associated with Foresight have legitimised and, in part, constituted the programme.

The cited drivers of the need for Foresight are diverse, multiple, and operate on a variety of levels. At the most general level, the globalisation of markets and the mobility of people and knowledge brings a fundamental change to traditional practices in public policy and the operation of firms. Much of the discussion of Foresight starts from the assumption that change is taking place at an increasing pace. The changes are happening at such a rate that no university, government, or business is unaffected. As the pace increases, organisations must find new ways of operating, networking, and responding to the competitive environment which, in part, requires long-term research planning. Change here is presented as inevitable and will have harsh impacts on those groups that do not prepare for the future.

Unless the UK responds to international competition with all the effort it can muster, it is argued, its current economic status cannot be maintained. The ever present threat of international competition is seen to necessitate the re-positioning of an (overall) structurally weak UK economy. At the level of public policy, the pace of advancement, the numerous lines of research opening up, the need to bring together multidisciplinary researchers, and the increasing technical sophistication of research all bring a need for co-ordination. This involves not only mapping future research opportunities and setting expenditure levels, but also characterising market demand for particular research, gauging national strengths and weaknesses in R&D, and determining the capacity of UK organisations to exploit that research. Since not enough funds exist to support all good projects, decisions must be made between funding disciplines in a manner that obtains 'value for money'. Foresight offers a response to these conditions. It is no coincidence that Foresight has its most thorough application in Japan, the centre of much of the threat of international competition from Pacific Rim countries.

Such revolutionary analysis typically relies on a certain reading of the past. As such, the portrayals of the past are part of justifying the policies of today and visions for the future. The past is depicted a more tranquil time where forms of prediction were possible, universities and other public researchers were relatively isolated from commercial concerns, and companies could rely on their suppliers and customers for innovative ideas. While the past may have had its own set of uncertainties, these were different in both degree and kind. Whereas extrapolation from then existing conditions might have provided an effective strategy for businesses and government policy before, today the situation has radically changed.

Those unable to step up to the challenge of competition today will face decline. The world is a hostile place where nation-states and corporations battle each other for supremacy. As the Foresight Steering Group report states:

Firms which perform poorly are forced to take adaptive action or go out of business. All companies are, however, forced into the continuous and accelerating pursuit of best practice. New tools have been deployed, in order to take advantage of information technology and the economies of scope and scale to be found beyond national markets. Such processes of adjustment may do little to ease competitive pressures, however, as firms become more like each other around the world, so competition can be expected to intensify.

Focusing on science, technology, and innovation is one way of maintaining competitive advantage. Change is not natural here, individuals and groups must respond to threats (through policies such as Foresight) rather than take a comfortable, relaxed position [21].

As the quotation above suggests, Foresight and the conditions necessitating it, require not just responding to change but embracing it. The only certainty today is uncertainty. Complacency is not an option. The rhetoric of Foresight does not just call for individuals to imagine the future, but tries to win consent that change is itself a virtue, necessary because of intense pressures. In this vein, Martin [8] acknowledges that Foresight activities will not succeed without a process of enrolment prior to the launch of such programmes, where the need for long-term policy becomes established. Even markets not traditionally technologically sophisticated will have to respond to the various revolutions. This characterisation of the pervasiveness of uncertainty though, has an uneasy relationship with attempts at casting the future as creatable because of initiatives such as Foresight. Where the uncertainty borders on the unknowable or uncontrollable is less than clear.

Change should not merely be thought of as the result of external pressures such as those of the international economy, but a positive, transforming challenge for actors. 'Ivory tower' academics and insular companies will no longer be able to get by. The transformation of individuals and organisations, in part, means involving them in dynamic network reconstructions. Actors will have to learn to face new challenges and Foresight is part of meeting that challenge. The vision here is one of organisational or managerial transformation towards general objectives (i.e., wealth creation and improved quality of life).

Foresight, along with many of the policy initiatives of the 1980s and 1990s, has not simply entailed a process of organisational restructuring, but also has been advocated as a means of reducing culture differences so as to break down the barriers between academia and industry [11]. In the main, this has meant instilling a culture of enterprise within the public sector research base, rather explicitly trying to change corporate culture (see below). In a situation of static public funding levels, bringing about a cultural change takes on a significant importance. In a situation where enterprise becomes the norm from which behaviour is judged, publicly funded researchers have a role to play in doing more with the same or less funding. Here a rhetoric of reinvention comes into play as those within academia and the public sector more generally are seen to be in need of breaking away from 'ivory towerism' and become a positive and productive force for wealth creation and improved quality of life for the UK. This change is not only an economic necessity, but also portrayed as desirable in its own right for liberating or encouraging academics from their (largely self-imposed) isolation.

Other characterisations of change implicit in Foresight discussions do not rest easily with a discourse of revolution. Foresight is sometimes portrayed as the natural response to several macro trends: growing technological sophistication and costs, internationalised markets, investors calling for increasing returns, knowledge dependence of economies, and the need to get the most out of resources. A majority of the knowledge in the world lies outside of particular organisations so there is a need to tap into this. Other countries have taken up Foresight as a response to these conditions, so the UK should take it up as well. As the OST explained,

Everyday our competitors hope to shape the future to their advantage. Without Foresight, therefore, we may be taking now paths which do not meet our long-term needs. The UK's major competitors undertake Foresight, and we cannot afford to give them a competitive advantage by neglecting to take up the Foresight Challenge [12] (p. 5).

Given the lack of any real agent it appears there is no particular agent pushing Foresight and thus being served by it. Since 'everybody is doing it', justifying the programme does not require a radical break from existing practices. The objectives of Foresight are incorporated into many past policies including, for instance, encouraging universities to be more interested in commercial work. In other words, as a prescription, Foresight follows from problems faced.

Also typically acknowledged in these sort of portrayals is that Foresight activities (in a some form) have been going on for quite some time. Foresight then is part of an incremental policy evolution and

is seen as deriving from a consensus over the desire for change. The programme here is not presented as very radical, so as not to alienate participants or affected individuals. The UK Foresight programmes comes from a long line of techniques developed by organisations such as RAND or Shell, and utilised nationally in countries such as Japan. If Foresight is taken as encompassing this very general meaning though, then it is not clear how it can be said to respond to current and changing innovation environments.

We see here something of the rhetorical repertoire those connected with Foresight can draw on. For instance, Foresight can be a response to innovative competition that places new demands on firms and universities, or can be an incremental, more natural progression of policy. The different rhetorics about legitimising the shift to Foresight are not mutually exclusive. In practice they are deployed as a series of intertwined statements which rarely need to be justified. Much of the rhetoric is international in its flavour and can be found in use outside of the UK. The ubiquity of science and technology policy rhetoric in general, of course, hides a great deal of diversity in the operationalisation of stories of change and strategy. The trick in any one programme is to bring together such a wide variety of statements. The rhetorical claims of Foresight constitute the programme as having a legitimate space in S&T policy and (some) researchers' agendas. The basis of this legitimisation though is not a singular discourse. Foresight is justified in multiple ways which offer different criteria for evaluating the exercise.

Co-ordination in policy

The last section argued that different and competing characterisations (e.g., evolutionary vs. revolutionary policy) are made on behalf of the Foresight programme. We can already see a certain ambiguity in the framing of why Foresight is a necessary and prudent policy. It is within these conditions that the programme has operated and it is necessary to consider how policies are implemented in this situation. This section describes how, in practice, Foresight comes to balance alternative accounts of its functions with a portrayal of the future as uncertain and yet creatable. Certain issues need to be addressed in order to do this, such as the sorts of decision making processes established for the programme and the assumption made therein about the role of politics in policy. In other words, this section goes on to further map the ambiguities of Foresight in asking how the UK Foresight process operationalises a future orientated agenda in practice. It does so, initially, by asking what relation Foresight has to rationalist policy models.

Foresight as long-range planning?

For policy makers faced with uncertainty about the future, conventional rationalistic approaches to managing research offer a couple of prescriptions. The first is to utilise long range planning techniques in order to make the future more predictable. To some degree Foresight does try to minimise uncertainty by influencing actors decisions today so as to make the future more predictable. As Ben Martin states, 'The aim of foresight is systematically to explore ... alternative futures. Thus, Foresight involves a consciously "active" attitude towards the future, recognising that the choices made today can shape or even create the future' [8] (p. 140) Yet, an amount of basic uncertainty and perhaps unknowability is also acknowledged.

In contrast to probabilistic assessments, the Foresight programme and many of the localised 'foresight' techniques (such as future scenarios, horizon scanning, and some forms of forecasting [27]) start from a recognition of the unavoidability of basic uncertainty, partially because such uncertainty has always existed, partially because of the pace and interdependency of knowledge dynamics today. Such strategic techniques are still concerned with finding ways of controlling the future. This is a future, however, which in many ways cannot be known. One way of coping with uncertainty is through instilling a sense of the core values of organisations. So, the formation of a shared sense of organisational identity is often cited as one of the primary benefits of engaging in the construction of future scenarios. The process of imagining future scenarios acts as a means of lowering the level of uncertainty and raising knowledge, but that is done with an acknowledgement of unavoidable uncertainty. Through imagining the future, Foresight tries to provide a way of coping with uncertainty.

Foresight as goal driven?

A second technique in conventional approaches is to try to increase top-down agenda setting mechanisms by establishing policies that set ever more narrowly defined goals and objectives in order to achieve greater accountability and 'value for money'. The imposition of agendas onto the research system can then bring about substantial change if the requirements for innovation do not match with the outputs of the research system. It is worth considering whether this is the case in Foresight.

When considering the effects of the recommendations, we can start off by noticing that Foresight has been advanced at a general level. Table 1 lists the priorities identified by the Health and Life Science (H&LS) panel. The prescriptions are quite imprecise, ambiguous and require interpretation as to how they should work in practice. So, for instance, questions could be raised about how these should translate into funding decisions and how the costs of pursuing certain priorities matches against their benefits. Because of this, it is not surprising the Research Councils found little in the way of disparities between the overall Foresight recommendations and their priorities [16, 17].

Table 1: Key recommendations of the H&LS panel

- * Infrastructure for exploitation and development. Economic success in the expanding life sciences sector needs close links between industry, health services, and a strong research base in the life sciences and clinical medicine.
 - * "Integrative biology": research programmes which integrate molecular biology and genetics with cell and tissue biology, and whole organism studies.
 - * Neuroscience and the cognitive sciences. Research into progressive degenerative disease and non- specific, age-related decline.
 - * Ageing. Basic research into ageing and disabling degenerative disease, coupled with technologies for sustaining reasonable quality of life for the elderly infirm.
 - * Genetics in risk evaluation and management. Understanding how genetic information can be applied to preventing and treating common multi-factorial diseases.
 - * Drug creation and delivery. Building the molecular, chemical, and biological expertise that will support new classes of therapeutic agents.
 - * Advanced recombinant technology. Research into key metabolic pathways, metabolic engineering, and applications in the biological manufacture of industrial products.
 - * Diagnostic applications of molecular biology. Applying research into disease at the genetic, molecular and cellular levels to develop new generations of diagnostics.
 - * "Immune manipulation". Research into the control of the immune system, and applications in specific interventions in inflammatory and immune disease, vaccines, transplants and other areas.
 - * Medical information technology. Innovative ways of using information and communication systems to inform and support clinical decisions, and medical practice in general.
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The ambiguous nature of the recommendations is not unique for policies as a '...vague language may be adopted as a deliberate strategy to facilitate compromise, allowing all sides of a dispute to retain hope that their interpretations will be embraced during the implementation process' [28]. While organisations on the sharp end of service delivery such as the UK National Health Service might benefit from specific priorities about specific issues aligned with their (short-term) research time horizons, such specificity can be an obstacle to achieving an air of consensus.

With regard to the recommendations of Foresight, there were initial worries that they would bring a fundamental change in the priorities of Research Councils and other public agencies by setting narrow goals [29]. The House of Commons Science & Technology Committee believed the changes brought about might 'have an immense influence on our national prosperity' [25] (p. v). Yet, such fears and hopes were unrealistic. By and large the participants in the panels were established players in the policy-making process. As such, any changes in policy were likely to be incremental in nature. Even with different groups being brought together, at the level of detail provided by Foresight, it is unlikely visions would vary substantially. Many of the initial fears over Foresight were based on an assumption that analysis, rather than a political process of participants interacting with one another, would be the basis of funding decisions. Den Hond and Groenewegen [30] argue that rationalistic assumptions behind most countries' Foresight programmes and the dominant role of elites in the process mean that foresight programmes, such as the UK one, afford few opportunities for anything but incremental change.

Initially, there were also worries that Foresight would undermine basic research as part of its fundamental transformation of S&T policy. As mentioned, the original name of the Foresight programme was the Technology Foresight programme. The focus on technology was feared by some to lead to a privileging of applied research. Great pains have been taken to make sure Foresight is not perceived as affecting the character or amount of basic research being undertaken [11]. The justifications for this are that the uncertainties associated with the growth in knowledge mean that it is not possible to predict the direction of scientific developments or the practical applications that might spin-off from basic research. Because of these factors it was claimed that trying to determine the pay-off of basic research is both inherently complex and perhaps misguided. Foresight must therefore seek to strike a balance between basic, strategic, and applied research.

In taking this stance, Foresight is rhetorically reproducing many past policies and their implications for the organisation of the research system as well as trying to ease potential worries from the academic community. As authors such as Sarewitz have argued [31], behind the cloak of government funding unfettered basic research hides a great deal of political manoeuvring between different disciplines for funding. If the implementation of Foresight does not compromise the character of basic research then this, in part, means not calling into question those "factors extrinsic to the research process, including the social hierarchies within the research community and the ideological and economic motivations that underlie ...support for science". Presumably, in the quest for relevance, Foresight could have challenged disciplinary divisions in funding given the diverse constituencies involved. However, calls for interdisciplinary research, such as integrative biology (see table 1), ultimately figure as small incentives for interdisciplinary research in an existing funding mechanisms rather than questioning the existing structure. The wider point here though is that any attempts to derive the proper balance between basic and applied research ultimately rests on a political settlement. How can anyone after all, in the abstract, show that a proper balance has been struck between basic and applied research? What does this imply for the distribution of funds across disciplines? In practice, such an evaluation is made in relation to previous funding levels and the vocalities of different disciplinary constituencies. In this situation, the effects of Foresight are likely to be quite limited.

Implications

At a general level then, Foresight has an ambiguous relation to attempts to instil some sort of conventional, instrumental, rationalistic programme for coping with uncertainty, both in its rhetoric and its implementation. As was suggested in the last section, there is some sense of a rational prescription for change here, one designed to promote greater communication and break down barriers. In other ways Foresight moves on debates about steering institutions to a different level in recognising uncertainty is unavoidable. Concerns over the relation of Foresight to rationalistic policy measures have significant implications for, among other issues, how we think about the role of politics in policy making and its neutrality. There have been fears as well that Foresight might be organised

in such a way as to deviate from an impartial, rationalistic model by favouring existing priorities or steering the priorities in a particular direction. There is the possibility that the structure of the Delphi or the co-nominated process for selecting participants may have a conservative effect on the diversity of views expressed [7]. The non-bias of Panels or other Foresight activities typically are discussed in terms of independence; the Panels should not be geared to predetermined conclusions (e.g., deriving from academics or industry). Georghiou [7] argues that the credibility of Foresight exercises depends on the extent of consultation or on the independence of the participants. Decisions about recommendations were supposed to be an outcome of a consensual process.

In this way, save for relatively minor worries over selection methods, Foresight is alleged to provide a non-partisan, depoliticised, and rationally-driven framework for making choices about futures. Nominated experts in different sectors make claims to knowledge that stand outside of partisan claims. Consensual analysis is supposed to provide the basis for policy. As analysts such as Lindblom and Woodhouse [28] have argued though, these sort of prescriptions are based on highly unrealistic assumptions about policy making. Decision making is instead often a matter of partisan interests vying with one another in situations of uncertainty for the definitions of problems and strategies for resolving them. Instead of bemoaning this condition, the interaction of partisans can promote a shared sense of agreement and achieve an intelligence that non-partisan analysis cannot. So, decision making-processes should try and find ways of promoting dialogue between different interests, rather than primarily asking experts to think the unthinkable and be the non-interested.

Interviews with those connected to the H&LS Panel suggests this lack of independence existed, though it was difficult to respond to this situation in the context of what Foresight asked of participants. Some of the interviewees described a 'role strain' in expecting to be non-interested and neutral while also having certain backgrounds, areas of interest and ignorance, and agendas. It is unrealistic to suppose individuals on Panels or elsewhere are not trying to make a case for certain areas, especially academics whose future funding opportunities may be affected. Such action is not simple manipulative or done out of self-interest, but instead reflects the limitations of the expertise of individuals and what can be expected from such a process. So, some H&LS panellists have argued that research related to animals or plants has not figured enough (or at all) in the programme or the activities of the Panel, and that some academics did promote certain lines of (personally relevant) research.

In a similar fashion, concerns can be raised about the benefits of the programme. Membership in the Sector Panels is the most important form of participation, though this is reserved for quite a small number of the 10,000 people who were supposed to have participated in and benefited from forms of consultation. As one H&LS panellist noted, while trying to adopt a notion of Foresight in which the greater good was the important consideration, he made contacts through panel participation that would be of benefit to his particular company. Here, the benefits gained by some through particular forms of networking might mean losses for their competitors. Whether or not this is just rewards for the time commitments and the insights offered by participants in the process is debatable. Either way, Foresight is typically pitched in terms of universal benefit or at least it is not portrayed as pitting one organisations against another.

Following on from the preceding section and this one, it is apparent that within Foresight at least two competing sets of claims exists. On the one hand, Foresight is about instilling certain values and forms of networking in the national research system without trying to give a direction to that system. In this sense, Foresight aims for flexibility and open-endedness. Research offers a means of coping with future uncertainty in scientific, technical, and market developments. On the other hand, while the future may be unknowable and uncertainty rife, choices must be made regarding funding priorities. Such decisions will influence the course of S&T development by prioritising some areas and marginalising others. The first claim more strongly resonates with the supposed benefits of Foresight as a process, the second to the products of Foresight. In this situation, policy has to find a legitimate basis for co-ordination when the future is supposed to be increasingly uncertain. Establishing this legitimacy requires a careful negotiation of uncertainty. If the future is uncertain but ultimately controllable or creatable, this takes us back to the days of planning and forecasting and does not necessitate significant changes in funding practices or S&T institutions. A future too uncertain though may cast fundamental doubts on existing institutions and imply a radical realignment of priorities. The need for radical realignment would no doubt raise numerous protests. Advocates of Foresight

might wish to destabilise funding mechanisms, but in a way that does not open up too many concerns over the existing systems. As a next step then, it seems appropriate to explicate the embeddedness of Foresight within the UK policy context.

Foresight in the UK policy context

The past sections have noted ambiguities in how the need for Foresight has been constructed, the conditions of change that make it attractive, and the manner in which it was organised. This section further examines Foresight by situating it in relation to wider UK S&T policy. Far from a decontextualised policy instrument responding to the present innovation environment in the model of rationality outlined above, it is argued Foresight should be understood in many respects as a continuation of past policies.

There has always been a basic problem in national S&T policies of how to set priorities and harness research towards national ends. With the central role of international competition in S&T policy, this problem takes the form of how 'to get policy and industry interested in the conduct of science and how to get science interested in the problems of policy and industry' [32]. The result has been a mix between top-down policy structures and bottom-up policy formation. The broad similarities in science policies and general institutions structures across countries (e.g., the peer review system, Research Councils) hides the different institutional relationships between the state and science [33].

Understanding the role of Foresight in policy decisions requires more than acknowledging national differences in Foresight programmes and the dependency of Foresight's impact on institutional contexts. Rather what is needed is an analysis of the positioning of Foresight between members of the research system and how within that system funding decisions are affected by expectations of the future, a future acknowledged as uncertain and yet 'createable'. In other words, Foresight must be understood as embedded in a particular political culture [34]. A key question we need to address is how Foresight programmes reflect, challenge, or further existing co-ordination processes. For instance, van der Meulen [32] suggests that Foresight activities in Germany serve as a tool for protecting vested interests organised in its rather rigid research system, instead of a means of providing flexibility. In the Netherlands, Foresight enters into the decision-making process of important intermediary groups between researchers and government.

To understand what might take place in the UK, it is worthwhile situating the UK Foresight programme within a somewhat more historical setting. No attempt will be made here to provide a comprehensive contextualisation, rather one aspect will be considered which figures centrally in the programme: the role of government in structuring relations between public and private actors. Edgerton and Hughes have analysed two faces of enterprise in UK science policy under recent Conservative governments. Despite the anti-technocratic rhetoric in the overall policies of these governments, they argue science policy has had a distinctly technocratic basis. While industry was seen as not investing enough in R&D, poorly managing existing R&D, and not realising the potential of the science base, there was little attempt to interfere directly in the operation of private organisations. Instead, "the market" was portrayed as deficient in providing the necessary information on the benefits of R&D and so the government assumed the role of trying to convince firms of R&D benefits. This concurs with Rip and van der Meulen [34] who characterise the UK as unique among major European countries in moving to a position of high state steering and low level of institutional structures for distributing and building research agendas.

As Robson [36] argues, the incorporation of accounting techniques for firm's R&D expenditure in the 1980s was one means of addressing the visibility and calculability of scientific practices and thus acted as a means of linking science and the health of the national economy. Heightening the visibility of R&D was supposed to encourage responsibility in private firms to further utilise R&D, crucially, without having to interfere directly with them. As Robson states, 'the primary thrust of governmental R&D policy was calculated to provide the circumstances within which industry would provide its own adequate level of funding for R&D' [36] (p. 504).

For publicly funded civil research policy, Edgerton and Hughes argue science and technology policy has unnecessarily embodied a centralisation mandate which promotes selectivity and decreases

flexibility. Much of policy has focused on promoting competition for research funds by controlling spending, tying in the agendas of researchers to users, and promoting various forms of public-private collaborations. The result has been to cut down on the very freedoms which an enterprise culture is supposed to foster. While this may be at odds with the desires of many academic and government scientists, such policy incorporates the views of elite scientists and science policy analysts, and crucially attempts to aid industry without directly interfering with them. Publicly funded science and technology are treated as subservient to industry, even though the latter's deficiencies are recognised. Although this may be at odds with many of the principles supposedly held by those in the New Right, it fits in with the overall goal of reducing the scope of the public sector.

Foresight does not embody a highly centralised agenda and so breaks from the general thrust Edgerton and Hughes describe. The programme relies on both forms of aggregating researchers' activities and proposes to establish incentive structures to steer actors towards certain areas. Yet, some points about the programme could be raised in relation to the issues mentioned above. At least in its first round, the programme may be reproducing many of the limitations of past government policies in not covering, in any sort of comprehensive or integrated manner, important aspects of policy (e.g., regulation, fundamental economic conditions), while blaming the research system for wider structural deficiencies [37]. Although the Panel reports note the importance of factors wider than technology or innovative to market success, the policy impact of Foresight on these areas has been limited.

In addition, despite the emphasis on uncertainty and the need to shape the future, Foresight embodies assumptions about what actions are appropriate, who is acting this way, and who must change. So, while the lack of mutual trust might be seen as a significant barrier to academic-industry relations, the blame for this falls with those in universities, or at the least they are the ones that are portrayed as needing to change their practices. Private industry is not compelled to take up recommendations, indeed it is acknowledged that there is limited awareness of Foresight in most of the private sector. While *Realising Our Potential* states that 'It will be for individual firms and organisations to decide for themselves what use, if any, to make of the result of [the Technology Foresight] programme' [11] (p.18), it also seems the case that the past and current government is doing what it can to make business appear to be heeding Foresight. The implicit argument is advanced in the programme's literature that industry should be listening and responding to the presented uncertainties of the current innovation environment. The tensions here between the government as a detached facilitator and an advocator of Foresight, can be understood in light of the characterisations of past policies as proactive and prescriptive, but not trying to seem as such.

At the level of resourcing, in the first round Foresight carried on the practice of giving much praise to the research system and the need for investments, but then not providing additional resources to substantiate this praise. So, while shortly after the publication of the Foresight recommendations, £40 million was announced for Foresight collaborative programmes, the same week saw significant government cuts in funding research [38]. Research money dedicated specially to Foresight priorities, such in the Foresight Challenge, have been rather limited and no doubt in many cases have funded existing planned collaborations. Though the importance of infrastructure funding was emphasised in Foresight such funding was not included in the programme [39].

Given this, the importance attached to the process in the UK is hardly surprising. But the focus on process is not divorced from the ambiguities of past policies. As a process Foresight is usually evaluated in terms of the numbers of documents circulated or attendees at conferences [17]. In light of the obvious limitations of such figures as a basis for evaluation, the 'counting numbers' approach is sometimes complemented by attempts to specify concrete benefits deriving from Foresight activities in related workshops (e.g., deciding on doable Foresight inspired projects). This desire to formalise informal exchange reflects the ambiguous position of government in trying to facilitate relations in a way that is not prescriptive, but also ensuring these interactions are structured and do lead to specifiable outcomes.

At the time of writing it is not certain how Foresight 2000 will differ from the first round. Some initial indicators seem to suggest that Foresight will move further into the incorporation of market considerations and away from a 'technology' focus [41]. The 'drift' of Foresight in incorporating market considerations more and more can be interpreted as an acknowledgement of the limitations to

the process so far. However, it is important to remember that those compelled to respond to the programme are publicly funded researchers. How far this 'market movement' can go without losing legitimacy or effectiveness in setting public funding priorities is an open matter, but these dangers are raised by the prospect of a shifting emphasis. The increase in public expenditure on S&T in the Research Councils and elsewhere announced by the Labour government in mid-1998 could both strengthen (by targeting research into identified priority areas) or weaken (by increasing the availability of funds for non-priority areas of research) the priority setting functions of Foresight.

By way of summary of this section, Foresight is an attempt to stabilise the turbulent conditions of late by engaging in a consultation process with academics, industrialists, and policy makers. In this context, Foresight is portrayed as a movement away from the past emphasis on centrally orchestrated government changes of recent times. In the past, additional mandates were imposed on the research system in a situation of resource constraints and competition. Foresight as a programme acknowledges the difficulties associated with central co-ordination and as a result does not seek to impose the agendas of certain groups on others but instead aspires to be a process of dialogue whereby diverse groups can come to some level of agreement over priorities. Whether or not Foresight achieves this in practice is debatable.

Conclusion

The previous sections have suggested that much of the significance of Foresight derives more from an attempt at defining 'the problem' with regard to UK S&T policy than providing a response to that problem. In its documents and activities, Foresight attempts to tell a story about what should be the core values of researchers, policy makers, and managers. The co-ordination in the programme is not an attempt to control, but rather an attempt to influence a large number of actors in a negotiating process. Foresight was meant to bring a new way of making tough choices about policy options. The international and national environment, as we are told, is one where the UK is compelled to find ways of steering research funding toward areas of excellence which are able to meet national goals. As a process, Foresight has aimed at creating the conditions whereby diverse groups can see themselves as playing an entrepreneurial role in the economy. The programme does not advocate the increase in top-down agenda setting mechanisms by establishing policies that set ever more narrowly defined goals and objectives. The state's role in co-ordination has been one of policy makers using their authority (but under constant pressures to secure their legitimacy) and their position to facilitate a process of negotiation over strategic goals among others actors, rather than attempting to control it in a very strict way. It has been argued here though that Foresight presents an ambivalent response to many of the concerns it proposes to address. Much of this ambivalence stems from the manner in which the programme distances itself from, and yet incorporates, certain questionable assumptions about the rationality of the policy process.

Foresight is part of the ever-present need to establish a 'social contract' between researchers, government, and the public. In recent years this has meant defining the role of government science and technology policy given the end of the Cold War. To the extent policy has changed, it is necessary to establish a new basis where decisions be justified. In attempting to do so though, Foresight embodies a number of tensions associated with:

- * different characterisations of the conditions of change Foresight is supposed to respond to;
- * its characterisations of the decision-making processes and the place of politics and analysis in policy making;
- * its continuity and discontinuity with past UK policy.

The extent to which these tensions manifest themselves depends on the degree to which Foresight has influenced policy, something that could only slightly be touched upon here. Despite the emphasis on uncertainty and the need to shape the future, Foresight embodies assumptions about what actions are appropriate, who is acting this way, who is resisting change, and what boundaries should not be crossed. As we ponder the next millennium then, we should be reminded that understanding where we are going with respect to an uncertain future requires understanding where we are coming from.

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